

REMARKS/ARGUMENTS

The Examiner objects to the drawings as failing to comply with 37 CFR 1.84(p)(5). The specification has been amended to overcome this objection.

The Examiner objects to the specification due to various informalities. The specification has been amended to address these informalities.

Applicants have canceled claims 19-27 and added new claims 28-36. The newly added claims are supported by the specification.

The Examiner rejects claims 1, 4-5, 10, 12-17, 19, and 21-27 under 35 U.S.C. §102(e) as being anticipated by Chang et al. (U.S. 6,818,043); claims 1,4-5, 8, 15-16, 19, and 21-27 under 35 U.S.C. §102(e) as being anticipated by Pennline et al. (U.S. 6,521,021); claims 1, 5, 8, 19, and 21-27 under 35 U.S.C. §102(e) as being anticipated by Hammel et al. (U.S. 2003/0219368); claims 3,6, and 7 under 35 U.S.C. §103(a) as being unpatentable over either one of Chang et al. '043, Pennline et al. '021, or Hammel et al. '368; claims 10 and 12-17 under 35 U.S.C. §103(a) as being unpatentable over either one of Pennline et al. '021 or Hammel et al. '368 in view of Bhat et al. (U.S. 5,672,323); and claims 2, 9, 11, 18, and 20 under 35 U.S.C. §103(a) as being unpatentable over either one of Pennline et al. '021 or Hammel et al. '368 in view of Bhat et al. '323 and further in view of Mazurkiewicz (U.S. 6,318,649).

Applicant respectfully traverses the Examiner's rejections. The cited references fail to teach or suggest at least the following italicized features of the pending independent claims:

1. A method for treating a contaminated gas stream, the gas stream comprising one or more contaminants, comprising:
 - combusting a feed material to produce a contaminated gas stream;
 - comminuting a plurality of sorbent particles having a first size distribution to form comminuted sorbent particles having a second size distribution, wherein the second size distribution is smaller than the first size distribution and wherein the comminuting step occurs on-site with a plant in which the feed material is combusted; and
 - thereafter introducing directly the comminuted sorbent particles into the gas stream to remove the one or more contaminants, wherein the comminuting step is performed in a jet mill.

10. A system for treating a contaminated gas stream, the contaminated gas stream comprising one or more contaminants, comprising:

a comminution device operable to effect size reduction of a plurality of sorbent particles and form a plurality of comminuted particles, *wherein the comminution device is a jet mill*;

a plurality of nozzles distributed through the gas stream and operable to introduce the plurality of comminuted particles into the gas stream; and

a particle removal device operable to remove at least most of the introduced comminuted particles and form a treated gas stream, wherein the comminution device is in direct fluid communication with the plurality of nozzles such that no intermediate storage of the comminuted particles takes place between the comminution device and the nozzles and wherein the plurality of sorbent comminuted particles are able to remove the one or more contaminants.

28. A method for treating a contaminated gas stream, the gas stream comprising one or more contaminants, comprising:

transporting a particulate unmilled sorbent material and coal from a remote location to a utility plant site;

combusting the coal to produce a contaminated gas stream;

milling the *unmilled* particulate sorbent material to produce a plurality of *milled* sorbent particles, the *unmilled* particulate sorbent material having a first size distribution and the *milled* sorbent particles having a second size distribution, wherein the second size distribution is smaller than the first size distribution and *wherein the comminuting step occurs on-site with the plant in which the coal is combusted*; and

thereafter introducing the comminuted sorbent particles into the gas stream to remove the one or more contaminants.

In one embodiment, the present invention is directed to the comminution of a sorbent before introduction into a contaminated gas stream. The comminution of the sorbent particles is typically performed on site and without intermediate storage. "On-site" refers to the general area of the combustion chamber, utility or other type of plant and can include transporting continuously the sorbent particles from a location near the chamber, utility or plant by means of a conveyor, slurry line, or pneumatic line, even though the location is not on the physical site of the chamber, utility or plant. The time between the completion of the comminuting and introducing steps is preferably no more than about 1 hour, no more than about 30 minutes, no more than about 10 minutes, no more than about 1 minute, preferably no more than about 30 seconds, and

most preferably no more than about 1 to 10 seconds. Normally, the comminution device is at least substantially co-located with the nozzles and remainder of the sorbent injection system.

The sometimes low contaminant removal rates of sorbents in commercial applications are believed, in large part, to be due to the agglomeration of particles during transportation from the manufacturer to the end user and during on-site storage before use. Agglomeration can dramatically change the effective particle size distribution. In other words, agglomeration can cause a larger mean and median sorbent particle size. When the sorbent is introduced into the gas stream, the larger particle size distribution provides, per unit of sorbent, fewer particles in the gas stream for contaminant sorption and removal. This can cause a substantially reduced sorbent removal efficiency. To attempt to overcome this problem, end users can introduce more sorbent per unit volume of gas stream, thereby resulting in much higher operating costs.

Chang et al.

Chang et al. is directed to method for efficiently removing vapor-phase contaminants from gas streams. A powdered adsorbent such as activated carbon is ground into a fine powder by wet grinding to form a slurry. Chemicals are added to the slurry to impregnate the sorbent to enhance sorbent effectiveness. The slurry chemical mixture is sprayed into the gas stream in the form of small droplets which evaporate to produce an aerosol of fine adsorbent particles. Vapor-phase contaminants in the gas stream adsorb onto the fine adsorbent particle surfaces and the adsorbent particles are removed from the gas stream by a conventional particle collection method.

At col. 4, lines 42-63, it is stated:

A grinder *positioned within the mixing chamber* grinds the sorbent powder into fine particles of less than approximately 5 .mu.m diameter while mixing the solvents and additives with the fine particles to form the slurry. One or more sorbent hoppers are provided for storing the sorbent powders, and one or more sorbent metering devices is provided for supplying the sorbent powders to the mixing chamber at a controllable rate. One or more solvent source containers is provided for storing said one or more solvents, and one or more solvent metering devices is provided for supplying the solvents to the

mixing chamber at a controllable rate. One or more chemical additive reservoirs is provided for storing said one or more chemical additives, and one or more additive metering devices is provided for supplying the chemical additives to the mixing chamber at a controllable rate. The slurry is delivered as a spray of fine droplets via an atomizer into the gas stream. The spray of fine droplets quickly evaporates in the gas stream to form a dispersed aerosol of fine sorbent particles impregnated with the chemical additives. These additive-impregnated aerosol particles adsorb vapor-phase contaminants from the gas phase and are then removed from the gas stream by a particle separator.

As can be seen from the above italicized language and with reference to Fig. 1, the grinder 20 is positioned within the slurry mixing vessel 22 followed by discharge of the slurry into the duct 30 by the atomizer 24. Although it is not clearly stated, it appears that the slurry is injected into the duct 30 shortly after sorbent comminution is performed.

In addition to the claim distinctions noted previously, neither U.S. 6,818,043 to Chang et al. is not prior art to the pending independent claims. As noted in the Declaration of Cameron Martin ("Martin Declaration") filed concurrently herewith, Chang et al. has a filing date of January 23, 2003, while the above-referenced patent application claims priority to a provisional application filed April 23, 2003. Exhibits "A" and "B" to the Martin Declaration describe the subject matter of pending independent claims and is dated before the filing date of Chang et al. (Martin Declaration at ¶¶ __ and __.) Additionally, the subject application was diligently prepared between the dates of Exhibits "A" and "B" and the filing date of the subject application. (*Id.* at ¶ __.)

Pennline et al.

Pennline et al. is directed to a system and method for removing mercury from the flue gas of a coal-fired power plant. Mercury removal is by adsorption onto a thermally activated sorbent produced in-situ at the power plant. To obtain the thermally activated sorbent, a lance (thief) is inserted into a location within the combustion zone of the combustion chamber and extracts a mixture of semi-combusted coal and gas. The semi-combusted coal has adsorptive properties suitable for the removal of elemental and oxidized mercury. The mixture of semi-combusted coal

and gas is separated into a stream of gas and semi-combusted coal that has been converted to a stream of thermally activated sorbent. The separated stream of gas is recycled to the combustion chamber. The thermally activated sorbent is injected into the duct work of the power plant at a location downstream from the exit port of the combustion chamber. Mercury within the flue gas contacts and adsorbs onto the thermally activated sorbent. The sorbent-mercury combination is removed from the plant by a particulate collection system.

At col. 4, lines 29-40, Pennline et al. discloses treatment of the extracted, pyrolyzed coal particles by a number of processes including grinding. However, it further teaches, at col. 4, lines 40-41, that the “thermally activated sorbent, whether chemically treated or untreated, may be stored in a hopper 52.” “An advantage to using a hopper 52 is that the thief, hollow lance, 40 may be operated periodically at the optimum combustion conditions to produce the thermally activated sorbent and then retracted when not in use to reduce the heat rate penalty created by the presence of the lance 40 within the combustion zone 24.” (Id. at col. 4, lines 42-48.)

Hammel et al.

Hammel et al. is directed to systems and processes for treating particulate oxides of manganese useful as oxidizing sorbents for capturing or removing target pollutants from industrial gas streams, including, but not limited to, nitrogen oxides (NO.sub.x), sulfur oxide (SO.sub.x), mercury (Hg), hydrogen sulfide (H.sub.2S), other totally reduced sulfides (TRS), and oxides of carbon (CO and CO.sub.2) gases. Oxides of manganese are washed an aqueous oxidizing solution, which may be adjusted as necessary to maintain the oxidizing solution a desired range of pH (acidity) and Eh (oxidizing potential) within the MnO.sub.2 stability area for aqueous solutions. The resulting treated oxides of manganese are equally or more efficient as sorbents as the oxides of manganese processed with the invention.

In ¶0074, it states:

In some removal systems the sorbent may be fed as a slurry or even as a wet sorbent cake and for such removal systems a drying step would not be required. However, where drying is required or desired prior to introduction into a pollution removal system, the wet sorbent cake is routed to a dryer 24. A variety of dryers known to those skilled in the art may be utilized for this purpose, such as a rotary kiln, heat exchanger, oven, or other suitable dryers. After drying the treated sorbent may require comminution and possible sieving to reduce the sorbent particles to the desired size. Further, the sorbent dryer 24 may be a standard cake or slurry drying system known to those skilled in the art of drying, which could include a fluidized bed dryer or a spray dryer, configured or designed to inject the wet cake or slurry of oxides of manganese sorbent into the flow of a gas stream prior to introduction into a reaction chamber of a pollutant removal system. Whether dried and comminuted or routed to a cake or slurry drying system, the resulting sorbent having increased loading capacity is ready for use in a pollution removal system.

Hammel et al. says nothing about whether the comminuted sorbent particles are stored before introduction to the duct or transportation of unmilled sorbent to a utility plant site where it is milled..

Bhat et al.

Bhat et al. is directed to the use of activated carbon injection for mercury removal in a flue gas treatment system having an electrostatic precipitator and a wet flue gas desulfurization tower. Fresh activated carbon is injected into the flue gas along with recycled carbon from the exhaust of the precipitator to minimize fresh carbon make up along with an activated carbon bed in the desulfurization tower to maximize mercury and other toxin removal from the flue exhaust.

At col. 2, lines 58-63, it is stated:

The activated carbon injection assembly 12 includes a hopper 20 for providing powdered activated carbon to a fluid bed 22 in an amount predetermined by a metering valve 24. The bed 22 maintains the powdered carbon in an actively mixed state by diverting flue gases from the flue 14 along vent 26 connecting the flue 14 to the fluid bed 22.

Thus, Bhat et al. teaches intermediate storage of the milled sorbent.

Mazurkiewicz

Mazurkiewitz is directed to a method for creating ultra-fine particles of material using a high-pressure [jet] mill. The method includes placing a material in a first chamber and subjecting the material to a high-pressure liquid jet to divide it into particles. These particles are then transferred to a second chamber in which they are subjected to cavitation to further divide the particles into relatively smaller particles. These relatively smaller particles are then transferred to a third chamber, in which the particles collide with a collider to still further divide them into ultra-fine particles of the material. The mill of the present invention includes a first chamber having an high-pressure liquid jet nozzle, first and second slurry nozzles, a second cavitation chamber and a third chamber which houses a collider. Sensors may be located throughout the mill to collect data on the comminution process and to use the data to control the resultant particle size. The product size of the ultra-fine particles made according to the mill of the present invention are preferably less than 15 microns.

The above references, individually and collectively, fail to teach or suggest the joint use of a jet mill, without post-comminution intermediate storage, followed by introduction of the comminuted sorbent into the flue gas.

Accordingly, the pending claims are allowable.

The dependent claims provide further bases for allowance.

By way of example, dependent claims 2, 8, and 32 require the comminuted or milled sorbent particles to be introduced into the gas stream in the absence of intermediate storage where the particles may reaggregate.

Dependent claims 3 and 33 requires the time between the completion of the comminution step to the introducing step is no more than about 30 seconds.

Dependent claims 5, 11, and 37 require the milling or comminuting step to be done in the absence or substantial absence of water. Chang et al., however, teaches away from dry comminution. Chang et al states at col. 2, lines 21-34, as follows:

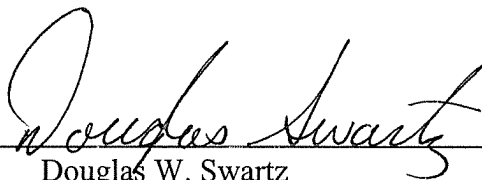
Modeling calculations and actual tests of mercury removal in coal-derived flue gas by sorbent injection demonstrate that smaller sorbent particle sizes increase removal efficiencies for mercury and other gas-phase-contaminants. The smaller the sorbent particle size for a given mass of sorbent, the better the mass transfer and therefore the better the mercury adsorption effectiveness. *However, simply grinding larger particle size activated carbon or other sorbent powders into smaller particles is not a straightforward process. There is an increased energy cost associated with formation of smaller particles, and this cost increases dramatically for particle sizes less than approximately 5 .mu.m. Activated carbon particles as small as 2 to 3 .mu.m in effective diameter may be formed through mechanical grinding, but this process becomes cost prohibitive from an energy standpoint. Additionally, dry grinding to form particles of this size frequently leads to severe dust problems during preparation, handling, and use of the activated carbon. Storage and feeding of very fine dry powders is further complicated by caking and clumping issues.*

(Emphasis supplied.) Chang et al. fails to teach the solution of the present invention to the dry grinding issue. Specifically, the joint use of a jet mill, without post-comminution intermediate storage, followed by introduction of the comminuted sorbent into the duct.

Based upon the foregoing, Applicants believe that all pending claims are in condition for allowance and such disposition is respectfully requested. In the event that a telephone conversation would further prosecution and/or expedite allowance, the Examiner is invited to contact the undersigned.

Respectfully submitted,

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